REMARKS

It has been noticed that inadvertently there are two claims numbered 25. Therefore, original claims 25 (second occurrence) through 29 are hereby renumbered 26-30. New claims 31-34 are added.

The examiner has rejected claims 2-16 and 18-21 under 35 U.S.C. 103 over Jin (EP 08 49796) in view of Grainger (U.S. patent 5,686,549) and in further view of Kotelnikov (RU 2089499). It is respectfully asserted that this ground of rejection is overcome by the instant amendment.

The claims, as amended, are directed to a *nanoporous silica film* produced by a process comprising the steps of reacting a suitable silica film on a substrate, with a surface modification agent to form a *hydrophobic coating on said film* and wherein the surface modification agent comprises at least one type of *oligomer or polymer* reactive with silanol groups on said silica film.

The examiner asserts that Jin et al. teaches several features of the presently claimed invention. Indeed, Jin et al. discloses dielectric materials comprising an organic silica dielectric on a surface. Further, Jin et al's pore surfaces may be rendered hydrophobic by rinsing with a *monomeric* material such as hexamethyldisilazane (HMDS). However, as the examiner admits, Jin *fails* to teach a surface modification agent which is an <u>*oligomer or polymer*</u>. Such is required by the present claims. Instead, Jin et al.'s reaction with monomeric HMDS serves to cap the silanols by forming trimethylsilyl groups which are significantly less polarizable than the original silanols of the silica, and render the pore surfaces of the film hydrophobic. This is disadvantageous because the use of trimethylsilyl groups are not very thermally stable and may out-gas during processing of interconnect structures and cause via poisoning.

The Examiner attempts to fill these deficiencies by citing Grainger and Kotelnikov. However, Applicants respectfully urge that there is no teaching or suggestion in either

Grainger or Kotelnikov which would lead one skilled in the art to combine these references with Jin in an effort to devise the present invention.

The examiner attempts to use Grainger to teach the use of an oligomer/polymer to impart hydrophobicity on a surface. Grainger relates to polymers which form ultrathin polymeric films which are bonded onto a substrate surface, to thereby impart various useful properties onto the surface. Indeed, one such property includes hydrophobicity. However, Applicants urge that Grainger fails to teach the formation of a *nanoporous silica* film on a substrate, wherein the pore surfaces of the film are rendered hydrophobic, as required by the present invention. Rather, Grainger teaches the formation of film on a *solid substrate surface*, followed by the imparting of hydrophobicity to the *substrate*. Furthermore, nowhere does Grainger teach the formation of a *porous* film which is hydrophobized, let alone a *nanoporous silica* film. In addition, Applicants submit that Grainger's long polymeric molecules formed by a Langmuir-Blodgett technique, for imparting hydrophobicity to the substrate *would not fit* into a pore structure of a nanoporous film, and thus would not be useful with the present invention. Thus, it is submitted that one skilled in the art would not look to the teachings of Grainger in an effort to devise the presently claimed invention.

Regarding Kotelnikov, it is further urged that the examiner is citing non-analogous art. Kotelnikov et al. relates to the oil and gas industry. It teaches the production of a material for use in oil and gas wells, for changing the oil- and water- permeability of strata formed in such wells. The material formed according to this reference is applied onto elements of oil-gas complexes to increase their resistance to aggressive media, corrosion, icing, and biological growth. This material taught by Kotelnikov is based on silica or metal oxide which is activated with carbonates of alkali metals and is then chemically modified with an organometallic compound at an elevated temperature. The result of this process is then additionally chemically modified by using an elemental-organic compound of formula Cl_4-nSiRn, where n is 1-3, and R is H, methyl-, ethyl-, Cl-methyl-, or phenyl-, and followed by an additional treatment with a compound selected from the group

including tetramethoxysilane, tetraethoxysilane, or an oligomer of polymethyl(ethyl)siloxane, or polymethyl silazane, in an amount from 0.5 to 1.0 weight percent. This reference clearly does not teach any starting material which is a nanoporous silica film on a substrate, having silanols on said silica film, as required by the present invention.

It is urged that there is no teaching or suggestion in the cited references which would lead one skilled in the art to combine Kotelnikov with Grainger with Jin. Not only would those skilled in the art not look to combine these cited references, but it is also submitted that such a combination would still fail to obviate the present claims, as amended. Thus, Applicants respectfully submit that the 35 U.S.C. 103 rejection should be withdrawn.

The examiner has rejected claims 22-28 under 35 U.S.C. 103 over Jin (EP 08 49796) in view of Grainger (U.S. patent 5,686,549) and in further view of Kotelnikov (RU 2089499). It is respectfully asserted that this ground of rejection is not well taken. The arguments for Jin, Granger, an Kotelnikov are repeated from above and apply equally herein. As stated above, each of these references fails to teach key features of the presently claimed invention. Jin *fails* to teach a surface modification agent which is an *oligomer or polymer*; Grainger fails to teach the formation of a *nanoporous silica* film on a substrate, wherein the pore surfaces of the film are rendered hydrophobic; and Kotelnikov, which is *completely non-analogous art*, does not teach a starting material which is a silica film on a substrate, having silanols on said silica film. Applicants urge that there is no teaching or suggestion in *any* of these cited references which would inspire one skilled in the art to combine these references in an effort to formulate the claimed invention. Furthermore, it is urged that such a combination would still fail to obviate the present claims. For these reasons and for the reasons argued for the rejection of claims 2-16 and 18-21 above, it is submitted that the rejection should be withdrawn.

The examiner has also rejected claim 17 under 35 U.S.C. 103 over Jin (EP 08 49796) in view of Grainger (U.S. patent 5,686,549), in further view of Kotelnikov (RU 2089499),

and in further view of Burns (U.S. patent 5,750,610). Applicants respectfully submit that this ground of rejection is not proper.

The arguments for Jin, Grainger, an Kotelnikov are repeated from above and apply equally herein. The Burns reference teaches the formation of hydrophobic organosilicate modified silica gels. However, it fails to teach a film on a substrate and importantly fails to teach or suggest an *oligomer or polymer* which is reactive with silanol groups on any such silica film. In fact, Burns et al. does not teach or suggest a surface modification agent at all, much less an *oligomer or polymer* which is reactive with silanol groups on a silica film.

The agents used by Burns, et al have the Formulas (I) or (II) on column 3, lines 25, et seq. and are enumerated on col. 6 line 3 through 52. Please note that both the generic formulas and each individual species pertains to a *monomer, not an oligomer or polymer* and certainly not an oligomer or polymer reactive with silanol groups on a silica film. The examiner apparently believes that because some of these monomers are mentioned to be high molecular weight, that they are thereby construed to oligomers or polymer. This is *not the case*. The examiner specifically points to column 7, lines 36-40 of Burns, et al for the proposition that Burns, et al employ oligomers. However, these are not oligomers or polymers. The are monomers.

Indeed, some of these same monomers may be employed as precursors to *form* the polymers and oligomers of this invention (see claim 8 wherein the Applicant's surface modification agent is prepared by *reacting* a suitable monomer with water in a solvent to form said surface modification agent); they may be employed as an *additional* component together with the oligomer or polymer (see claim 15). However, their use in this manner does not detract from the fact that an oligomer or polymer surface modification agent is required by the claims and absent from Burns, et al.

In addition, Burns, et al does not teach a nanoporous silica film on a substrate, wherein the surface the silica film is to be hydrophobized. Rather, Burns et al. form a reaction product of a silica with an organosilane and a strong acid in a flask (see examples), to provide a hydrophobized reaction product. Such does not pertain to a coating on a substrate at all. Therefore Burns is to be considered non-analogous art to the modification of dielectric films on a substrate.

For the foregoing reasons, it is urged that one skilled in the art would not be imbued with an inspiration to formulate the presently claimed invention upon a combining of Jin, Grainger, Kotelnikov, and Burns. Applicants therefore respectfully urge that the 35 U.S.C. 103 rejection be withdrawn.

The examiner has rejected claims 2-28 under the non-statutory, judicially created doctrine of obviousness-type double patenting over claims 1-19 of U.S. patent 6,318,124 (Rutherford et al.) in view of Grainger (U.S. patent 5,686,549) and in further view of Kotelnikov (RU 2089499. It is respectfully submitted that the rejection is not well taken.

The present invention relates to a *nanoporous silica film* produced by a process comprising the steps of *reacting* a suitable silica film *on a substrate*, with a surface modification agent to form a hydrophobic coating on said film and wherein the surface modification agent comprises at least one type of *oligomer or polymer* reactive with silanol groups on said silica film.

Rutherford et al. discloses a surface-coated nanoporous silica dielectric film in which a polymeric layer is deposited onto a silica dielectric film on a substrate. Rutherford, et al then may apply a *monomeric* surface modification agent such as those enumerated on column 8, lines 15, et seq. The surface of the nanoporous silica dielectric film is then coated with a polymer layer. However, none of the claims indicate that their surface modification agent is an oligomer or polymer *reactive with silanol groups* on a silica film. The Rutherford, et al coating materials are different than the surface modification agents within the scope of the claimed invention and do not form coatings on silica dielectric films as the claimed films in which surface modification agents which are

oligomer or polymer reactive with silanol groups on said silica film and form a hydrophobic coating thereon.

As stated above, Grainger teaches the formation of ultrathin polymeric films which are bonded onto a substrate surface, to thereby impart hydrophobicity and the like to that surface. The examiner attempts to use Grainger to teach the use of an oligomer/polymer to impart hydrophobicity on a surface. However, as stated above, Grainger fails to teach the formation of a *nanoporous silica* film on a substrate, wherein the pore surfaces of the film are rendered hydrophobic. Rather, Grainger teaches the formation of film on a *solid substrate surface*, followed by the imparting of hydrophobicity to the *substrate*. Furthermore, nowhere does Grainger teach the formation of a *porous* film which is hydrophobized, let alone a *nanoporous silica* film. It is further submitted that the long polymeric molecules used by Grainger for imparting hydrophobicity to the substrate *would not fit* into a pore of a nanoporous film, and thus would not be useful with the present invention.

As stated above, Kotelnikov et al. relates to the oil and gas industry. It teaches the production of a material for use in oil and gas wells, for changing the oil- and water-permeability of strata formed in such wells. The material taught by Kotelnikov is based on silica or metal oxide which is activated with carbonates of alkali metals and is then chemically modified with an organometallic compound at an elevated temperature. The result of this process is then additionally chemically modified by using an elemental-organic compound of formula Cl_4-nSiRn, where n is 1-3, and R is H, methyl-, ethyl-, Cl-methyl-, or phenyl-, and followed by an additional treatment with a compound selected from the group including tetramethoxysilane, tetraethoxysilane, or an oligomer of polymethyl(ethyl)siloxane, or polymethyl silazane, in an amount from 0.5 to 1.0 weight percent.

Kotelnikov certainly discloses the *use* of an oligomeric or polymeric surface modification agent, however is specifically teaches only injecting an oil well with a surface

modification agent which is an oligomer or polymer. This reference clearly does not teach any starting material which is a silica film on a substrate, having silanols on said silica film, as required by the present invention. Thus, it is urged that one skilled in the art would not look to combine Kotelnikov with Grainger and/or Rutherford in an effort to devise the presently claimed invention.

Applicants urge that the present invention is materially different, and thus patentably distinct, from Rutherford et al. in view of Grainger and Kotelnikov. It is further urged that there is no teaching or suggestion in any of these references that would not have imbued one skilled in the art with an inspiration to devise the presently claimed invention upon a reading of the cited references. Applicants therefore respectfully submit that the obviousness-type double patenting rejection is improper and should be withdrawn.

The undersigned respectfully requests re-examination of this application and believes it is now in condition for allowance. Such action is requested. If the examiner believes there is any matter which prevents allowance of the present application, it is requested that the undersigned be contacted to arrange for an interview which may expedite prosecution.

Respectfully submitted,

Richard S. Roberts
Reg. No. 27,941
P.O. Box 484
Princeton, New Jersey 08542
(609) 921-3500
Date: March 25, 2003

I hereby certify that this paper is being facsimile transmitted to the Patent and Trademark Office (FAX No. 703-308-7722) on March 25, 2003.

Richard S. Roberts
Reg. No. 27,941